CHAPTER 4.
GEOMORPHOLOGY

The observations and conclusions in this chapter are based on a review of existing geologic soil maps, USGS topography maps, aerial photography, and estimated changes in the EIA for future buildout. Only limited field observations were carried out.

4.1 GEOLOGY AND SOIL TYPE

The Boise Creek Basin was largely formed by, and is underlain by, deposits of the Osceola mudflow. The portions of the basin in the Cascade Mountain foothills are underlain at a shallow depth by Tertiary bedrock. The basin originally was fully forested, but logging began in the region in the late 1800s.

The primary soil units in the study area are listed in Table 4-1 and shown in Figure 2-6. The primary soil types in the upper basin east of the Enumclaw Golf Course are Barneston, Kanasket, Pitcher, and Playco, based on the Snoqualmie Pass Soil Survey. These are generally moderately to very deep well-drained soil with moderate permeability above bedrock. The depth to bedrock typically varies from 40 to 60 inches. The lower basin is primarily Alderwood and Everett gravelly sandy loam, based on the King County Soil Survey.

4.2 GEOMORPHOLOGICAL CHARACTERISTICS

Figure 2-7 shows the topography of the Boise Creek Basin. The total drainage area is 9,861 acres and the elevations vary from 630 feet above mean sea level at the confluence of Boise Creek and the White River to 3,900 feet.

The upper basin is relatively steep and any transported sediment from Subbasins 6 and 7 is deposited either in the ponds upstream of the Weyerhaeuser plant or in the large side channel around the old Mill Pond. Some fine suspended sediment may be transferred downstream of Highway 410. The channel reach between Highway 410 and the Enumclaw Golf Course was partially realigned when Highway 410 was constructed in 1936. Erosion within this reach has contributed to sediment deposition problems in the golf course area because the stream gradient through the golf course is much flatter. Below the golf course from River Mile 3.2 to River Mile 1.2 the channel is very flat and the average stream velocity is approximately 2 feet per second. Once Boise Creek reaches River Mile 1.2, the channel steepens to a slope of 2.2 percent to the White River.

Each subbasin was analyzed based on current and future land use. Table 4-2 summarizes the findings of the analysis. Table 2-13 lists the change in the effective impervious area from existing conditions to future buildout and the percent forest cover for future buildout. In Subbasins 1, 2, and 4, EIA exceeds 10 percent or forest cover is less than 65 percent. These areas were further examined to determine whether channel changes have occurred and if any future actions are required to improve the system.

TABLE 4-1.
PRIMARY SOIL UNITS IN THE BOISE CREEK BASIN

Soil Unit	Hydrologic Soil Group
Alderwood gravelly sandy loam	C
Barneston gravelly coarse sandy loam	B
Beausite gravelly loam	C
Buckley sandy loam	C
Christoff sandy loam	C
Everett gravelly sandy loam	A
Haywire loamy sand	C
Indianola	A
Jonas gravelly silt loam	B
Kanaskat gravelly sandy loam	B
Littlejohn gravelly sandy loam	C
Nagrom gravelly loam	C
Newberg till	B
Norma loam	D
Ovall gravelly loam	C
Pitcher sandy loam	B
Pits	D
Playco loamy sand	B
Puyallup fine sandy loam	B
Ragnar loam	B
Reichel silt loam	B
Seattle muck	D
Shalcar muck	D
Sultan silt loam	C
Winston loam	B
Zynbar silty loam	B

Group A: Well drained; high rate of transmission; sand, loamy sand
Group B: Moderately well to well drained; moderate infiltration rate; silt loam or loam
Group C: Low infiltration rate; moderately fine to fine texture; sandy clay loam.
Group D: Soils have high runoff potential; very low infiltration rate; shallow soil over nearly impervious material.

Source: SCS, TR55, June 1986

TABLE 4-2.
STREAM REACH DESCRIPTIONS

Subbasin	Primary Soil Unit	Channel Conditions	Possible Channel Impacts Based on Total Buildout
1	Alderwood Gravelly Sandy Loam and Buckley Silt Loam	Channel slope is 2.2%. The channel has a dense tree canopy. Some sloughing along channel, and the channel bottom is stable. The channel bottom width is approximately 30 feet wide and the depth varies from 6 to 25 feet.	Erosion and channel sloughing are expected to continue.
2	Alderwood Gravelly Sandy Loam	Channel has been straightened for many years. The channel slope is 0.2%. Approximately 30% of channel has some tree cover. No significant channel erosion or sloughing. The upper reach of the subbasin has a bottom width of 10 feet and a depth of 6 feet compared to the lower reach, which has a channel width of 20 feet and a depth of 6 to 20 feet.	This reach of channel currently has insufficient capacity for approximately a 10-year storm event. If the capacity of the upper reach of this channel is not increased, more frequent flooding will occur in the future, particularly near 268th Avenue SE (RM 2.2). Channel velocities are low so no significant erosion problems are anticipated but sediment deposition is a problem.
3	Alderwood Gravelly Sandy Loam	The channel slope is 8.3% from the headwaters to 286th Avenue SE and 1.0% from 286th to Boise Creek; there is a potential for erosion upstream of 286th and sediment deposition below 286th. No problems have been reported	The channel may need to be stabilized upstream of 286th. Erosion is expected to occur because of the steep channel gradient and sediment deposition will continue to occur below 286th.
4	Alderwood Gravelly Sandy Loam and Everett Gravelly Sandy Loam	The channel within the golf course has been modified by past channelization, dredging and ongoing vegetation removal. The average channel slope is 0.7%. Sediment deposition from Subbasin 5 has added to the flooding of the golf course.	The existing channel is subject to frequent overtopping during significant storm events, but no structures are flooded. King County is proposing to relocate the channel to improve fish habitat and reduce flooding of the golf course.

TABLE 4-2 (continued).
STREAM REACH DESCRIPTIONS

Subbasin	Primary Soil Unit	Channel Conditions	Possible Channel Impacts Based on Total Buildout
5	Barneston Gravelly Coarse Sandy Loam and Kanaskat Gravelly Sandy Loam	Channel slope is 3.2%. The channel alignment was modified by Highway 410. The stream banks were stabilized with large woody debris to help reduce downstream sedimentation. The LWD was flushed downstream during subsequent large storms and came to rest in a low-gradient area at RM 5.0, where it has induced a substantial amount of sediment trapping and recruiting of natural small and large woody debris. A 30-foot high waterfall at RM 4.4 forms a complete fish passage barrier.	No development is expected in this subbasin. The upstream basins are currently forest area except for the Weyerhaeuser Mill, which is proposed to be closed. The diversion structure and the gate on the side channel around the old millpond will need to be maintained. Some additional stream bank stabilization may be required in this reach.
6	Arents, Kanaskat Gravelly Sandy Loam, and Barneston Gravelly Sandy Loam	The channel slope varies from 1% to 30% upstream of the Weyerhaeuser plant and less than 1% downstream of the plant. A 48-inch bypass conveys the stream under the plant. No sediment or flooding problems have been reported. Some water quality problems (sediment and oils & greases) have been reported at the plant and have been handled by King County Department of Natural Resources and Parks. Any large sediment that reaches the old millpond site is expected to settle out in the channel.	No development is expected in this subbasin and the upstream basin is currently zoned forest. The Weyerhaeuser Mill is proposed to be closed, the diversion structure and the gate on the side channel around the old millpond will need to be maintained.
7	Kanaskat Gravelly Sandy Loam, Pitcher Sandy Loam, and Playco Loamy Sand	There are few roads in this area. The area has been logged in the past. The average channel slope is approximately 12%	This subbasin is currently forested and no changes are expected in the next 10 years.

4.3 CONCLUSIONS AND RECOMMENDATIONS

The upper basin for Boise Creek is located in a forest reserve area and minor changes are expected in this area. The lower basin has been developed, but except for Subbasins 1, 2 and 4, the EIA is less than 10 percent. The percent forest cover is also greater than 65

percent for Subbasins 4 through 7. Currently, significant erosion is occurring in Subbasins 1 and 5 and deposition in Subbasin 4. We do not expect that this will increase significantly in the future and it may actually be reduced if recommended actions listed in Chapter 9 are implemented.